Baseline Survey of the Benthic Macrofauna of Twofold Bay, N.S.W., with a Discussion of the Marine Species introduced into the Bay

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A baseline survey of the benthic macrofauna of Twofold Bay, southern N.S.W., was carried out during 1984-85. Sampling was concentrated in intertidal and shallow subtidal habitats. Samples were collected seasonally and, although sampling was largely qualitative, some attempts were made to assess the abundance of species and this is indicated in the species list given.

The survey originated in response to a study on ballast water which is regularly discharged into Twofold Bay (Williams *et al.*, 1988). The ballast water contained living organisms and Williams *et al.* (1988) suggested that these animals could survive discharge into the Bay.

The purpose of this survey was to conduct a baseline study of the macrofauna of Twofold Bay and to determine if any non-indigenous species had been introduced into the bay. Seven introduced species were found and the possible methods by which these became established in the bay are discussed.

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INTRODUCTION

Background to Study

During the 1970s considerable concern was expressed both overseas and in Australia on the likelihood of marine introductions via ballast water discharged into ports. Subsequent colonization and the potential for the development of them to become 'pest' species was also of concern (Friese, 1973; Medcof, 1975; Medcof and Wolf, 1975). Carlton (1985, 1987) has recently reviewed species introduced via ballast water on a world wide basis.

In response to this concern primarily within the fishing industry, the then New South Wales Department of Fisheries, now the Department of Agriculture and Fisheries, undertook a survey of the ballast water of Japanese ships discharging ballast water into selected Australian ports. Their survey revealed a variety of living organisms in the ballast water belonging to a number of groups, including 8 non-indigenous species (6 copepods, 1 mysid and 1 amphipod) and an additional 14 species of copepods and 4 non copepod taxa with an Indo-Pacific distribution. Twenty one copepods and 22 other species, from the ballast water sampled, could not be identified to species. Sediment in the bottom of the ballast water tanks contained 8 non-indigenous species, 8 cosmopolitan and 27 other taxa not identified (Williams *et al.*, 1988). They determined by experiments that such organisms could survive discharge through the pumps into the water and thus could possibly settle and establish populations in an Australian port.

Twofold Bay on the south coast of New South Wales (37°05′S, 149°54′E) is one of the ports identified by Williams *et al.* (1988) as receiving ballast water containing living organisms on a regular basis from northern Japan during loading of woodchips at the wharf on the southern shores of the bay. Medcof (1975), in an earlier survey had also found living ostracods, crustacean larvae, adult and larval polychaetes and chaetognaths in ballast water of a woodchip carrier at Eden, Twofold Bay.

Twofold Bay has been a port since the late 1800s, for a variety of goods including whale products, gold, agricultural produce and most recently for woodchip (Matthews, 1947). Thus considerable scope has existed for introductions via fouling organisms on the bottoms of ships and more recently via ballast water (Medcof 1975; Williams *et al.*, 1988). The marine fauna of the bay has not however been documented.

During 1984 and 1985, The Australian Museum undertook a baseline study of Twofold Bay as a follow-up to the survey of Williams *et al.*, 1988. The aims of the survey were (1) to document the macrobenthic fauna of the area, and (2) identify any marine introductions. Any species recognized as non-indigenous to the area, could then be the subject of a subsequent study, to assess what impact, if any, this species is having on the natural fauna and recommend control measures. This baseline study will also facilitate the documentation of any subsequent introductions.

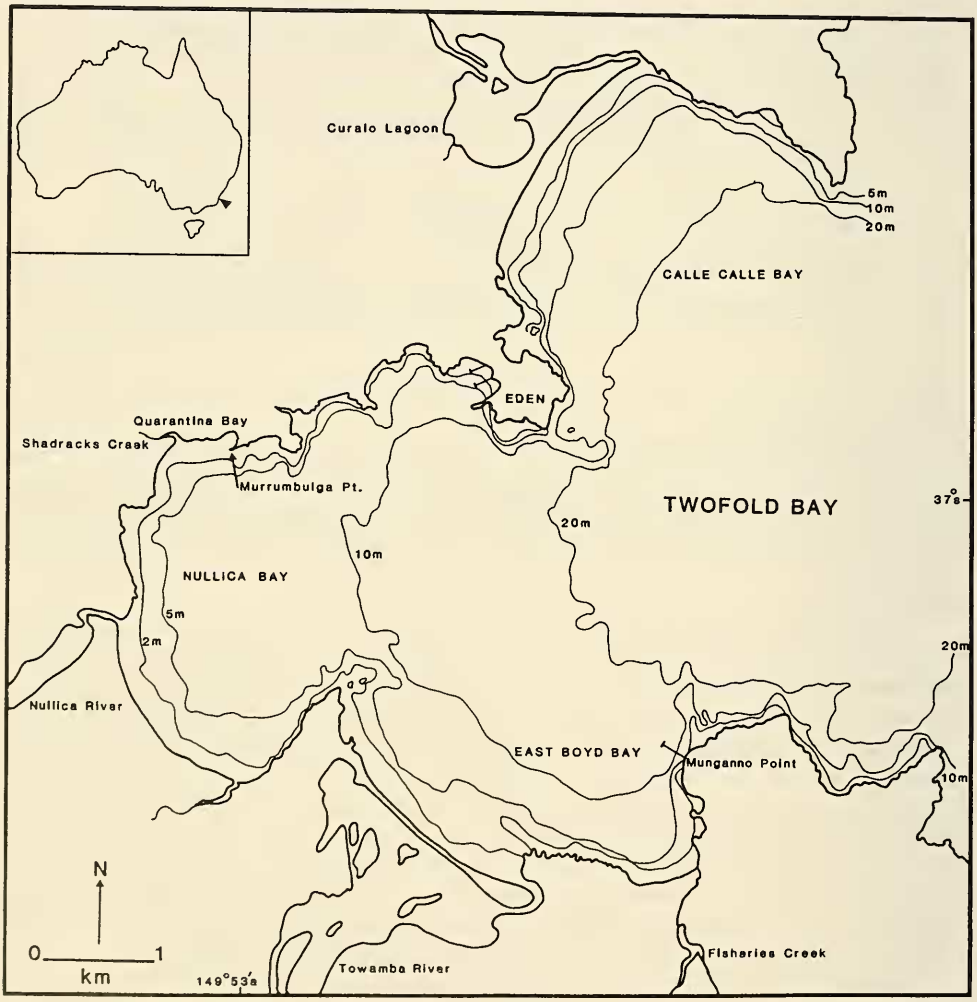

Fig. 1. Map showing location of sampling sites within Twofold Bay.

Study Area

Twofold Bay is a large open bay, consisting of 3 smaller bays, Calle Calle, Nullica and East Boyd Bay (Fig. 1). The headlands and corresponding rock platforms are of

Devonian sedimentary strata. The beaches between these bays are mini-barrier dune systems which form Curalo Lagoon and are also evident at the mouth of Fisheries Creek, Towamba and Nullica Rivers.

Rationale for sampling strategy

Ballast water is usually taken on board after unloading the cargo. Ports are usually sited in estuarine or shallow protected bays so that the fauna taken on board with the ballast water is primarily permanent estuarine plankton and planktonic larval stages of estuarine or shallow water species. The adults of such species tend to live as encrusting organisms or benthic organisms in soft sediment or seagrass communites, therefore sampling was concentrated in these habitats.

TABLE 1

A Breakdown of the various Types of habitats sampled at each Site

- Hard substrata (epifauna)
  - natural
    - intertidal
      - marine
        - sheltered ..... Murrumbulga Pt
        - exposed ..... Munganno Pt
      - estuarine (oysters) ..... Nullica River, Fisheries Creek
    - subtidal
      - sheltered ..... Murrumbulga Pt
      - exposed ..... Munganno Pt
  - artificial — wharf piles, breakwater ..... Munganno Pt, Quarantine Bay
- Soft substrata (infauna)
  - marine
    - shallow — *Posidonia* (seagrass beds) ..... Quarantine Bay
    - deep (10-20m) — pipe dredge sampling marine sand
  - estuarine
    - lagoon, *Ruppia* (seagrass beds) ..... Fisheries Creek
    - tidal, *Zostera* (seagrass beds) ..... Nullica River, Curalo Lagoon, Shadracks Creek
    - saltmarsh ..... Fisheries Creek, Curalo Lagoon

METHODS

The habitats sampled in Twofold Bay (Table 1) were: —

a. Fouling communities on wharfs and piles.
b. Seagrass communities at the mouth of rivers and creeks.
c. Soft bottom communities and intertidal encrusting fauna in shallow estuarine areas.
d. Intertidal rocks around the loading wharf at the woodchip mill.
e. Saltmarsh areas.

No attempt was made to sample the pelagic or planktonic communities within the Bay.

Fig. 1 indicates the location of each of the sampling sites. Details of sampling and the number of samples collected in each habitat are given in Table 2. A variety of qualitative collecting techniques were used to sample the fauna, although in the Appendix some indication of abundance is given for each species.

Details of collection methods appear in Hutchings *et al.* (1986a, b).

TABLE 2

Details of Times of Sampling at each Site and the Number of Samples collected in each Habitat, during each Collection Period
Unit of collection = 36cm x 44cm plastic bag
Variation between months in collection unit number caused by bad weather and time available for collection

SAMPLE REPLICATES		COLLECTION UNITS					
SITES	YEAR	1984		1985			
	MONTH	SEPT	DEC	MAR	JUN	SEPT	DEC
Munganno Point							
Intertidal rock platform		3	2	2	3	3	4
Subtidal rock platform		3	1	1	2	1	2
Wharf piles		3	2	3	3	3	5
Airlift sediment		1	1	1	—	—	— (a)
Fisheries Creek							
Intertidal rocks		—	1	1	1	1	1
Sand sievings (intertidal)*		6	6	6	6	6	6
Mud sievings (intertidal)*		6	6	6	6	6	6
Mud sievings, *Ruppia**		6	6	6	6	6	6
Saltmarsh		6	1	1	1	1	1
Nullica River							
Sand sievings (intertidal)*		—	6	6	6	6	6
Mud sievings (intertidal)*		6	6	6	6	6	6
Mud sievings, *Zostera**		6	6	6	6	6	6
Intertidal rocks		2	1	2	1	1	2
Shadracks Creek							
Mud sievings, *Zostera**		6	6	6	6	6	6
Sand sievings (intertidal)*		6	—	—	—	—	— (a)
Murrumbulga Point							
Intertidal rock platform		2	2	3	3	3	3
Subtidal rock platform		5	2	3	3	3	2
Quarantine Bay							
Airlift sediment (*Posidonia*)		4	4	4	4	4	4
Amphipod trap, wharf		1	—	1	1	1	1
Curalo Lagoon							
Sand sieving, *Zostera**		6	6	6	6	6	6
Saltmarsh		1	1	1	1	1	1
Total		79	66	71	71	70	74

* Hand corer used.
(a) Discontinued.

On one occasion, permission was given by the shipping authorities to collect the accumulated sediment in the bottom of the ballast water tanks.

Salinity was measured during each collecting period for the estuarine areas sampled.

a. Description of Sampling Sites and Salinity Regimes

1. *Curalo Lagoon*

A shallow brackish water lagoon behind the most northern beach in Twofold Bay. It was closed to the sea in July 1984 for a short period and during this time the lagoon was virtually fresh and the bar was breached between July and September 1984. The lagoon

then remained open to the sea for the rest of the survey and the salinity ranged for 20-32°/oo, with an average of 26°/oo. *Zostera* seagrass beds were present near the entrance; they replaced *Ruppia* seagrass beds present before the salinity increased. An extensive saltmarsh occurs on the eastern margin.

2. *Murrumbulga Point*

A south-east facing sheltered rocky shore with the intertidal rock platform approximately 15-20m wide, which has been eroded flat, with scattered rubble, boulders and sand occurring at the north-eastern end. Zonation is not as apparent as at Munganno Point, described below, because of its more sheltered nature, gentle slope and the presence of numerous tidal pools.

The subtidal rock 'platform' is boulder-strewn and uneven, extending gradually to a depth of 9m. The boulders have a cover of kelp and other algae, while the crevices are dominated by sea urchins and encrusting red calcareous algae.

3. *Quarantine Bay*

This bay is protected from heavy seas by a breakwater. Patchy *Posidonia* seagrass beds begin at approximately 2m depth between the rocks and sand. Encrusting and cryptic fauna were also collected from these rocks. The pylons of the recreational/public boating wharf and the intertidal breakwater wall were examined.

4. *Shadracks Creek*

A brackish tidal creek with sandy banks and *Zostera* seagrass growing on a rubble covered mud bottom. It forms a small lagoon behind Legges Beach. It had an average salinity of 14.5°/oo (range 0-27°/oo) and was closed in March, 1985, and remained closed for the rest of the sampling period.

5. *Nullica River*

The estuary has extensive intertidal mud and sand flats. *Zostera* seagrass grows in the channel and tide pools and oysters cover the intertidal rocks. It was always open to the sea at times of sampling with an average salinity of 21.7°/oo (range 11-30°/oo).

6. *Fisheries Creek*

A brackish tidal creek with intertidal mud and sand flats, oyster covered rocks, and the seagrasses *Zostera* and *Ruppia* growing in the deeper back waters. Saltmarshes are present along the bank.

The creek showed an average salinity of 29.8°/oo (range of 20-36°/oo), with salinity falling steeply from the mouth to the seagrass beds, a distance of approximately 500m. The creek was closed to the sea in March 1985 and in full flood in December later that year.

7. *Munganno Point*

A north-west facing exposed rocky shore with the intertidal rock platform approximately 4m wide, backed by a small cliff. The platform varies from a steeply sloping rock face to loose piled rubble with a few tide pools. There is some evidence of zonation. The lower zone is dominated by cunjevoi (*Pyura stolonifera* (Heller)) and mat-forming weed. The upper zone is dominated by serpulid worms (*Galeolaria caespitosa* Savigny) and barnacles. The subtidal rock platform is a tiered 'patchy' outcrop of rocks which extends down to sand at approximately 6m depth. The rocks support a healthy cover of kelp (*Ecklonia radiata* (C.Ag.) J.Ag).

The wharf at Munganno Point extends from the shore for 244m, with maximum water depth 15m. The pylons are constructed of concrete-encased steel. Pylons close to the shore are thickly encrusted with calcareous serpulid worm tubes intertidally, whilst supporting a heavy growth of tunicates, sponges and kelp for their entire length below the low water mark.

Results

In the Appendix the macrobenthic fauna collected at each locality is given, together with an indication of abundance and frequency. Many of the polychaetes and small crustaceans have been identified only to the generic level, as they represent either new species or new records for the area. Representatives of each taxon have been lodged at the Australian Museum and assigned registration numbers to facilitate further identification or confirmation.

The following species have been introduced and are non-indigenous to the bay: *Styela plicata* (Ascidian); *Polycera capensis*, *Theba pisana* and *Crassostrea gigas* (Molluscs); *Notomegabalanus algicola*, *Carcinus maenas* and *Eurylana arcuata* (Crustaceans). Each of these is discussed in detail below.

Styela plicata (Lesueur)

This ascidean or sea squirt has long been known to occur on Australian shores. We recorded it from the subtidal rocks amongst the *Posidonia* seagrass in Quarantine Bay. It has a wide distribution within Australia and is found in many ports of the world.

Recent analysis of the biogeography of this species has indicated that it is non-indigenous to Australia (Kott, 1985). *Styela plicata* is a recognized fouling organism and is likely to have been introduced to Australia attached to ships' hulls. The earliest Australian records date from 1878.

The origin of the Twofold Bay colony is unknown. It may have resulted from the spread of populations already established in Australia or as a direct import from overseas shipping. This could have occurred at any time during the 150 years that the port of Twofold Bay has existed (Matthews, 1947).

Theba pisana (Muller)

This salt-tolerant terrestrial snail was collected from the terrestrial margins of the saltmarsh at Curalo Lagoon. It is recognized as a pest of agricultural crops and gardens (Smith and Kershaw, 1979).

Baker (1986) has reviewed the introduction and spread of *T. pisana* in Australia. It first appeared in South Australia prior to 1928. It is now widely distributed over most of southern Australia but appears to favour a mediterranean-type climate. Its previous distribution includes Europe, the Mediterranean, North Africa, Atlantic Isles and British Isles. It has also been introduced to North America and South Africa.

The mode of introduction into Australia is not known, but it may have been brought to Australia as a food item by Italian migrants (P. Colman, pers. comm.).

Crassostrea gigas (Thunberg)

The Pacific oyster was recorded, in small numbers, at Twofold Bay on the intertidal rocks at the mouth of the Nullica River. This is the first record of occurrence in Twofold Bay (T. Mundy, pers. comm.).

Shipments of the Pacific oyster were made from Japan in 1947-8 to establish populations in southern Tasmania (Thomson, 1952). In 1955, adult Pacific oysters from Tasmania were transported to Mallacoota, Victoria, just south of Twofold Bay. By 1958 a

quarter of the population was still alive, but no spatfall was observed during this time (Thomson, 1959).

Wolf and Medcof (1973-4) documented the distribution of *Crassostrea gigas* in New South Wales. They provide an accurate documentation of all the Australian introductions and subsequent dispersal of stock. Although they did not record the species from Twofold Bay, the oyster was recorded from Pambula (1967) and Merimbula (1973) just to the north. Subsequent papers (Medcof and Wolf 1975; Holliday and Nell, 1985; Coleman, 1986) have further examined the expansion of the range of *Crassostrea gigas* and discuss the problems this oyster has caused in the N.S.W. oyster industry which has traditionally been based on the Sydney rock oyster *Saccostrea commercialis*. A breeding population of *C. gigas* has established itself in Port Stephens, N.S.W. (Holliday and Nell, 1985).

The Pacific oyster is providing a case study of the effects of a 'pest' on an established fishery.

Polycera capensis (Quoy and Gaimard)

The first Australian records of this opisthobranch mollusc date from 1927, the animals being collected from Sydney Harbour and described by Allan (1932) as a new species *Polycera conspicua*.

Thompson (1975) reported that the species described by Allan (1932) had been synonymized with *Polycera capensis* (Quoy and Gaimard) a species commonly found in, and first described from, South Africa. Thompson (1975) also noted that further specimens had been taken from Sydney Harbour and Botany Bay, N.S.W., where the species was at least seasonally abundant.

Burn (1978) gives the Australian distribution of *P. capensis* as the area between Broken Bay and Kiama, N.S.W.

Willan and Coleman (1984) repeated the Australian distribution given by Burn (1978) and state '*P. capensis* was probably introduced to Australia by shipping'.

A single specimen was collected in December 1985 by us from Twofold Bay, at the subtidal rocks Munganno Point, adjacent to the woodchip loading wharf. Specimens were also taken from this area by Rudman (pers. comm.) in March, 1986.

The evidence to date suggests that *P. capensis* has been introduced into Australia from South Africa, by ship fouling. It may have been introduced to Twofold Bay either directly in this manner or from the dispersal of populations established in other Australian ports.

Polycera capensis was not recorded by us as an introduction to Twofold Bay in our original report (Hutchings *et al.*, 1986b) as the literature relating to it has only recently been brought to our attention.

Notomegabalanus algicola (Pilsbry)

This barnacle was originally described from South Africa and was first noted in Australia by Pope in 1943 (see Allen, 1953). It seems likely that the first introduction occurred in the Sydney region, although the barnacle may have been introduced into New South Wales on several occasions.

Allen (1953) records this barnacle from Eden to Port Stephens and suggests that it was transported to Australia as a fouling species on the bottom of ships. Allen states that during the late 1940s to early 1950s it rapidly increased in numbers and became one of the most common sublittoral barnacles on the open coast. The record of this barnacle from Twofold Bay is therefore not surprising. It was found to be very common on the intertidal rocks and wharf piles of Munganno Point.

Carcinus maenas (Linnaeus)

This species, also known as the European swimming crab, was first recorded from Australia by Fulton and Grant (1900; 1901) from Port Phillip Bay, Victoria. They suggest it was introduced amongst the dense fouling growth on the bottoms of wooden ships and that the young crabs could easily live amongst this growth during the long sea voyage from Europe.

This crab has since been recorded from Westernport Bay to Mallacoota (Allen, 1953), and Healy and Yaldwyn (1970) recorded it as quite abundant on parts of the Victorian coastline. Day and Hutchings (1984) tentatively recorded it from Merimbula, New South Wales, and specimens with collection localities in the vicinity of Narooma, New South Wales, are held at the Australian Museum. We have found it commonly around Twofold Bay, amongst intertidal rocks as well as intertidal mud. Our survey thus confirms the continued extension of *C. maenas* populations to the north. Recent introductions of *C. maenas* have also been reported in South Australia, and a single specimen has been found in Western Australia (Zeidler, 1978; Rosenzweig, 1984).

To date, no information is available on the impact of this introduced species on our native populations. Overseas experience indicates that such an 'aggressive predator' constitutes a potential threat to native marine fauna (Joska and Branch, 1986).

Eurylana arcuata (Hale)

This cirolanid isopod is well known only from New Zealand and Chile, South America. It is believed to have been a recently-introduced species in San Francisco Bay, U.S.A. (Bowman *et al.*, 1981). Bowman *et al.* suggest the isopod could have been introduced to San Francisco Bay in this case either in fouling, such as that found on propeller-shaft housing, or via ballast water. They gave three localities in Australia where this isopod has been previously reported (Port Jackson and Broughton Island, New South Wales and Port Willunga, South Australia) and suggested that it may have been introduced at these points. Bruce (1986) has recorded a single specimen from Newcastle harbour and Day and Hutchings (1984) recorded the species tentatively from Pambula and Merimbula. At Twofold Bay, the species occurred on the intertidal rock platform at Murrumbulga and offshore in deep water sediments.

This disjunct distribution within Australia, associated with port facilities, and the fact that *Eurylana arcuata* is not recognized as an active swimmer (N. Bruce, pers. comm.), indicates that it may have been introduced on several different occasions at different localities.

Sediment in ballast water tanks

The sediment collected from the bottom of the empty ballast water tanks contained one juvenile crab and 60 copepods. The crab was identified as *Charybdis* cf. *feriatus* which has an Indo-Pacific distribution from Japan and East Asia to the east coast of Africa and south to Victoria, Australia. No specimens of this species were recorded during the survey and we cannot be certain that the crab was alive when the mud was collected although it was well preserved and its presence in the sediment confirms the findings of Williams *et al.* (1988).

The 60 copepods present in the mud have not been identified further. However the material has been deposited in the Australian Museum.

Discussion

The benthic macrofauna of Twofold Bay is a rich and diverse one, with over 570 taxa collected. This number includes 13 species of demersal fish which normally inhabit

the seagrass beds which were sampled for their benthic invertebrates. This level of richness appears high for southern New South Wales and exceeds the 246 invertebrate species identified at nearby Merimbula (Day and Hutchings, 1984). There is some overlap in species composition in the comparable habitats sampled at these two localities.

Of the seven marine species recorded during this survey as non-indigenous to Twofold Bay, two may have been introduced via ballast water, *Eurylana arcuata* and *Crassostrea gigas*. The remaining species, with the exception of *Theba pisana*, were probably introduced as fouling organisms. The influence of these seven introduced species on the ecology of the indigenous marine life in the bay is not known. To date only the Pacific oyster *Crassostrea gigas* has been recognized as posing a possible commercial threat to fisheries and this is a state wide problem not one restricted to Twofold Bay. The spread of *Carcinus maenas* along the southern and south-eastern Australian coastline and possibly into Western Australia may warrant further studies including ones to assess the impact this species has on the local fauna.

Joska and Branch (1986) describe *Carcinus maenas* as an 'aggressive predator' where 'the great strength of its nippers and its aggressive, non-selective predatory habits have made it a pest in at least one of its adopted habitats'. They report *C. maenas* feeding on the clam-beds on the New England coast of the U.S.A.

This survey provides a basic inventory of the macrofauna of shallow intertidal and subtidal benthic communities in Twofold Bay and should allow any subsequent introductions to be identified and the timing of the introduction to be assessed.

To date we believe that the evidence for introductions via ballast water into Twofold Bay are only tentative and the effect on the native fauna not well documented except in the case of *Crassostrea gigas*. Suggestions made by Paxton and Hoese (1985) and Williams *et al.* (1988), that all ballast water being discharged into Australian ports be treated in order to kill any living organisms before the water is discharged, are at this stage we believe premature. The problems of introducing the necessary legislation which would involve co-operation between several countries, and the enforcing of any such legislation are such that far more documentation of introductions via ballast water and their impact on the native fauna is needed for their justification. Carlton (1985, 1987) in a recent review of ballast water introductions summarizes those attributed to ballast water but in many cases the data substantiating such a mechanism of introduction is fairly tenuous. Instead of pursuing costly legislation to sterilize ballast water, baseline surveys of the fauna and flora of those Australian ports which regularly receive ballast water (especially those which receive ballast water from ports subjected to similar water temperature regimes as those in the Australian port) should be conducted.

Such a monitoring programme and the identification of any introduction and documentation of the impact these introductions are having on the natural fauna will provide the necessary data which would be necessary before any legislative programme could even be considered and drawn up and enforced.

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References

ALLEN, J. K., 1932. — Australian Nudibranchs. *Aust. Zool.* 7(2): 87-105.

ALLEN, F. E., 1953. — Distribution of marine invertebrates by ships. *Aust. J. mar. Freshwater Res.* 4(2): 307-316.

BAKER, G. H., 1986. — The Biology and Control of White Snails (Mollusca: Helicidae), Introduced Pests in Australia. C.S.I.R.O. Australia. Division of Entomology Technical Paper No. 25. 31pp.

BOWMAN, T. E., BRUCE, N. L. and STANDING, J. D., 1981. — Recent introduction of the cirolanid isopod crustacean *Cirolana arcuata* into San Francisco Bay. *J. Crust. Biol.* 1(4): 545-557.

BRUCE, N. L., 1986. — Cirolanidae (Crustacea: Isopoda) of Australia. *Rec. Aust. Mus. Suppl.* 6: 1-239.

BURN, R., 1978. — A new record of *Thecacera pennigera* (Montagu, 1815). Opisthobranchia: Polyceridae) from New South Wales. *J. Malac. Soc. Aust.* 4(1-2): 22.

CARLTON, J. T., 1985. — Transoceanic and interoceanic dispersal of coastal marine organisms: the biology of ballast water. *Oceanogr. Mar. Biol. Ann. Rev.* 23: 313-371.

——, 1987. — Patterns of transoceanic marine biological invasion in the Pacific Ocean. *Bull. Mar. Sci.* 41(2): 452-465.

COLEMAN, N., 1986. — A review of introductions of the Pacific oyster (*Crassostrea gigas*) around the world and a discussion of the possible ecological consequences of introducing the species into Victoria, Australia. Marine Science Laboratories, Technical Report No. 56. 39pp.

DAY, J. H., and HUTCHINGS, P. A., 1984. — Descriptive notes on the fauna and flora of Merimbula, Pambula and Back Lakes, New South Wales. *Aust. Zool.* 21(3): 269-289.

FRIESE, U., 1973. — Another Japanese Goby in Australian waters; what next? *Koolewong. Proc. Roy. Zool. Soc. N.S.W.* 2: 5-7.

FULTON, S. W., and GRANT, F. E., 1900. — Note on the occurrence of the European crab, *Carcinus maenas*, Leach, in Port Phillip. *Victorian Nat.* 17(8): 147-148.

——, 1901. — Some little known Victorian Decapod Crustacea with Description of a New Species. *Proc. Roy. Soc. Vict.* 14(2): 55-64.

HEALY, A., and YALDWYN, J., 1970. — *Australian Crustaceans in Colour.* Sydney: Reed.

HOLLIDAY, J. E., and NELL, J. A., 1985. — Concern over Pacific oyster in Port Stephens. *Aust. Fish.* 44(11): 29-31.

HUTCHINGS, P. A., van der VELDE, J. T., and KEABLE, S. J., 1986a. — Colonisation of New South Wales by non-indigenous marine species. Baseline studies at Twofold Bay, New South Wales. Unpublished final report to the Fisheries Industry Research Committee. FIRTA 84-89. 71pp.

——, 1986b. — Colonisation of N.S.W. by foreign marine species. *Aust. Fish.* 45(4): 40-42.

JOSKA, M. A., and BRANCH, G., 1986. — The European shore-crab. Another alien invader? *Afr. Wildl.* 40(2): 63-65.

KOTT, P., 1985. — The Australian Ascidiacea Part 1. Phlebobranchia and Stolidobranchia. *Mem. Qld Mus.* 23: 1-440.

MATTHEWS, L. J., 1947. — Eden, Twofold Bay. Its Rise, Decline and Return to Prosperity. *Port of Sydney Journal* 1(3): 89-92.

MEDCOF, J. C., 1975. — Living marine animals in a ship's ballast water. *Proc. natl Shellfish. Ass.* 65: 54-55.

——, and WOLF, P. H., 1975. — Spread of Pacific oyster worries New South Wales culturists. *Aust. Fish.* 34(7): 32-38.

PAXTON, J. R., and HOESE, D. F., 1985. — The Japanese Sea Bass, *Lateolabrax japonicus* (Pisces, Percichthyidae), an Apparent Marine Introduction into Eastern Australia. *Jap. J. Ichthyol.* 31(4): 369-372.

ROSENZWEIG, P. A., 1984. — A range extension for the European shore crab *Carcinus maenas* (Linn, 1758) in South Australia. *Sth Aust. Nat.* 59(1): 18-19.

SMITH, B. J., and KERSHAW, R. C., 1979. — *Field Guide to the Non-Marine Molluscs of South Eastern Australia.* Canberra: Australian National University Press.

THOMPSON, T. E., 1975. — Dorid nudibranchs from eastern Australia (Gastropoda, Opisthobranchia). *J. Zool. Lond.* 176: 477-517.

THOMSON, J. M., 1952. — The acclimatization and growth of the Pacific oyster (*Gryphaea gigas*) in Australia. *Aust. J. Mar. Freshwater Res.* 3(1): 64-73.

——, 1959. — The naturalization of the Pacific oyster in Australia. *Aust. J. Mar. Freshwater Res.* 10(2): 144-149.

WILLAN, R. C., and COLEMAN, N., 1984. — *Nudibranchs of Australasia.* Sydney: Australian Marine Photographic Index.

WILLIAMS, R. J., van der WAL, E. J., and KELLY, J., 1988. — Ballast water as a possible vector for the transport of non-indigenous marine species. *Estuarine, Coastal, Shelf Science* 26: 409-420.

WOLF, P. H., and MEDCOF, J. C., 1973-4. — Be on your guard against the Pacific oyster. *The Fisherman* 4(10) 3-5, 24-25.

ZEIDLER, W., 1978. — Note on the occurrence of the European shore crab *Carcinus maenas* (Linn., 1758) in Australia. *Sth Aust. Nat.* 53(1): 11-12.

APPENDIX
INVENTORY OF MARINE FAUNA COLLECTED FROM TWOFOLD BAY
(In alphabetical order within the major taxonomic groupings)

The *frequency* refers to the rate of recurrence or number of collections in which it was found:

Occasionally (o)	$0 < x < 2$
Usually (u)	$2 < x < 4$
Regularly (r)	$4 < x < 6$

where x represents the number of collections.

The *abundancy* was a subjective measure of how plentiful the species was, based on the total numbers collected in that group. As the project was essentially a qualitative exercise sampling method and effort varied. Thus comparisons between groups proved difficult and a sliding scale was adopted. For example:

Few (f)	=	not many, small in number for polychaetes	$x < 20$
		molluscs	$x < 20$
		(peracarid (small) crustacea	$x < 50$
		other crustacea	$x < 20$
Abundant (a)	=	plentiful, polychaetes	$20 < x < 50$
		molluscs	$20 < x < 40$
		(peracarid crustacea	$50 < x < 100$
		other crustacea	$20 < x < 40$
Numerous (n)	=	consisting of a great number, polychaetes	$x > 50$
		molluscs	$x > 40$
		peracarid crustacea	$x > 100$
		other crustacea	$x > 40$

where x represents the number of specimens.

The *sites* are Curalo Lagoon — 1, Murrumbulga Point — 2, Quarantine Bay — 3, Shadracks Creek — 4, Nullica River estuary 5, Fisheries Creek — 6, Munganno Point — 7, Reconnaissance trip (12-13/7/84) — 8, Deepwater benthic sampling (20-22/2/85) — 9.

Classification & Designation	Frequency/ Abundancy	Found at Sites	Registration Nos
PHYLUM: COELENTERATA			
Phlyctenactis tuberculosa (Quoy & Gaimard)	o/f	2,7	G15228
PHYLUM: PLATYHELMINTHES			
CLASS: TURBELLARIA:			
Acoela spp.	u/a	2,3,7	W201435-6
PHYLUM: NEMERTINEA			
Nemertean ?sp.1	r/n	1,2,3,5,6,7	W201433-4
Nemertean ?sp.2	u/a	2,3,5,7	W201431-2
Nemertean ?sp.3	r/a	2,3,5,7	W201429-30
Nemertean ?sp.4	r/a	2,6	W201427-8
Nemertean ?sp.5	o/f	4,7	W201426
Nemertean ?sp.6	o/f	7	W201425
PHYLUM: ANNELIDA			
CLASS: POLYCHAETA			
ORDER: ORBINIIDA			
FAMILY: ORBINIIDAE			
Leitoscoloplos normalis Day	u/a	1,2,3,4,5,6	W201397
Scoloplos (Scoloplos) cylindrifer Ehlers	o/f	1	W201400
Scoloplos (Scoloplos) novaehollandiae (Kinberg)	o/f	1	W201399
Scoloplos (Scoloplos) simplex (Hutchings)	u/f	1,2,3,4,6	W201398
FAMILY: PARAONIDAE	o/f	5	W202618
ORDER: SPIONIDA			
FAMILY: SPIONIDAE			
Aonides oxycephela (Sars)	f	3,5	W201392
Australospio trifida Blake & Kudenov	f	7	W201396
Boccardia chilensis Blake & Woodwick	f	2,5,7	W201391
Boccardiella sp.	f	2	W201388
Carazziella victoriensis Blake & Kudenov	f	3	W201390
?Laonice sp.	f	2,5,7	W201393
Malacoceros sp.	f	6	W201387
Polydora socialis (Schmarda)	f	3,7	W201389
Polydora cf. *woodwicki*	f	5	W201394
Polydora sp.	f	3,5	W201385
Prionospio cirrifera Wiren	f	2,3	W201395
Prionospio cf. *cirrifera*	f	4,5	W201386
Prionospio multipinnulata Blake & Kudenov	f	2,3,7	W201384
Spio pacifica Blake & Kudenov	f	6	W201383
FAMILY: MAGELONIDAE	o/f	5	W201382
SUB ORDER: CHAETOPTERIFORMIA			
FAMILY: CHAETOPTERIDAE			
Mesochaetopterus sp.	o/f	7	W199764
SUB ORDER: CIRRATULIFORMIA			
FAMILY: CIRRATULIDAE			
Cirriformia capensis (Schmarda)	f	2,7	W202616
Cirriformia filigera (delle Chiaje)	f	2,5	W202617
Dodecaceria sp.	o/f	2	W199748
ORDER: CAPITELLIDA			
FAMILY: CAPITELLIDAE			
Barantolla lepte Hutchings	o/f	5	W201381
Capitella 'capitata' (Fabricius)	o/f	1	W20138
Leiocapitella sp.	o/f	7	W201378
Notomastus torquatus Hutchings & Rainer	o/f	5	W201379

Appendix cont'd.

FAMILY: MALDANIDAE			
Axiothella sp.	u/a	1,2,3,5	W199732-41
Euclymene trinalis Hutchings	o/f	3	W199742
ORDER: OPHELIDA			
FAMILY: OPHELIIDAE	u/f	7	W202619
FAMILY: SCALIBREGMIDAE	o/f	2,3	W201412
ORDER: PHYLLODOCIDA			
SUB ORDER: PHYLLODOCIFORMIA			
FAMILY: PHYLLODOCIDAE			
Anaitides longipes (Kinberg)	r/a	2,3	
Eumida cf. *sanguinea*	r/a	2,7	W202472
Phyllodoce novaehollandiae Kinberg	r/a	1,3,4,5,6	entire
Phyllodoce sp.1	u/f	6,7	family
Phyllodocid sp.1	o/f	2	currently
Phyllodocid sp.2	o/f	7	being
Phyllodocid sp.3	o/f	7	revised
SUB ORDER: APHRODITIFORMIA			
FAMILY: POLYNOIDAE			
Harmothoe sp.1	u/f	2,3,7	W201418
Harmothoe sp.2	r/a	2,3,5	W201417
Lepidasthenia sp.	o/f	7	W201422
Lepidonotus carinulatus Grube	o/f	5	W201421
Lepidonotus melanogrammus Haswell	o/f	7	W201420
Lepidonotus n.sp.1	r/a	2,5,6,7	W201416
Lepidonotus n.sp.2	r/a	2,3,7	W201415
Lepidonotus n.sp.3	r/a	2,7	W201414
Lepidonotus n.sp.4	o/f	2	W201419
FAMILY: SIGALIONIDAE			
Psammolyce cf. *antipoda*	u/f	3	W201413
Sigalion bandaeensis Horst	o/f	5,6	W199763
FAMILY: CHRYSOPETALIDAE			
Chrysopetalum sp.1	r/a	2,7	W199721-31
SUB ORDER: NEREIDIFORMIA			
FAMILY: HESIONIDAE			
Podarke angustifrons (Grube)	r/a	2,3,5,7	W201374
FAMILY: SYLLIDAE			
Autolytus sp.1	u/f	7	W201364
Autolytus sp.2	o/f	7	W201365
Autolytus sp.3	o/f	7	W201366
Autolytus sp.4	o/f	2	W201367
Syllid ?sp.1	r/n	1,2,3,5,6,7	W201368
Syllid ?sp.2	r/n	1,2,7	W201369
Syllid ?sp.3	r/a	2,3,7	W201370
Syllid ?sp.4	o/f	4,7	W201371
Syllid ?sp.5	o/f	2,7	W201372
Syllid ?sp.6	u/f	2,7	W201373
FAMILY: NEREIDIDAE			
Australonereis ehlersi (Augener)	r/a	1,2,5,6	W201361
Ceratonereis aequisetis Augener	r/n	1,2,3,4,5,6,7	W201362
Nereis maxillodentata Hutchings & Turvey	o/f	7	W202521
Nereis cf. *triangularis*	o/f	7	W202607
Perinereis amblyodonta (Schmarda)	r/n	1,2,3,4,5,6,7	W201363
Platynereis dumerilii antipoda Hartman	o/f	2,3,5,7	W202610
SUB ORDER: GLYCERIFORMIA			
FAMILY: GLYCERIDAE			
Glycera tridactyla Schmarda	o/f	3,9	W199743-7

Appendix cont'd.

FAMILY: NEPHTYIDAE			
Nephtys australiensis Fauchald	r/n	1,3,4,5,6	W200238-337
ORDER: AMPHINOMIDA			
FAMILY: AMPHINOMIDAE			
Euphrosine n.sp.	o/f	7	W199762
ORDER: EUNICIDA			
FAMILY: EUNICIDAE			
Eunice aphroditois (Pallas)	r/a	2,7	W201411
Eunice cf. *australis*	r/a	2,7	W201410
Eunice torresiensis McIntosh	o/f	7	W201409
Eunice tridentata Ehlers	o/f	2	W201408
Eunice tubifex Crossland	o/f	7	W201407
Marphysa sanguinea (Montagu)	o/f	2	W201406
Nematonereis unicornis (Grube)	u/f	2,7	W199804-5
Palola sp.1	o/f	7	W201405
FAMILY: ONUPHIDAE			
Diopatra dentata Kinberg	r/a	2,7	W200191-202
FAMILY: LUMBRINEREIDAE			
Augeneria verdis Hutchings & Murray	o/f	3,7	W201403
Lumbineris latreilli Audouin & Milne Edwards	o/f	5	W201402
FAMILY: ARABELLIDAE			
Arabella iricolor iricolor (Montagu)	o/f	2,3,7	W201401
Arabella n.sp.1	r/n	1,2,3,5,6,7	W198896-976
FAMILY: LYSARETIDAE			
Lysidice cf. *collaris*	r/a	2,3,7	W19773-802
Lysidice ninetta Audouin & Milne Edwards	o/f	7	W199803
?Lysidice sp.	o/f	2	W201404
FAMILY: DORVILLEIDAE			
Dorvillea australiensis (McIntosh)	o/f	2,3,7	W199751-4
Protodorvillea sp.	o/f	6,7	W199749-50
Schistomeringos loveni (Kinberg)	u/f	2,3,5	W199755-9
ORDER: OWENIIDA			
FAMILY: OWENIIDAE			
Owenia fusiformis delle Chiaje	r/n	1,3,4,5,6	W200203-34
ORDER: TEREBELLIDA			
FAMILY: SABELLARIIDAE			
Idanthyrsus pennatus (Peters)	u/a	2,7	W199879-95
FAMILY: AMPHARETIDAE			
Isolda pulchella Muller	u/a	2,7	W199760-1
FAMILY: TEREBELLIDAE			
Lanassa ocellata Hutchings & Glasby	o/f	2	
Lanice bidewa Hutchings & Glasby	o/f	9	W201375
Longicarpus modesta Hutchings & Murray	u/a	2,7	W200388-97
Nicolea amnis Hutchings & Murray	r/a	2,3,7	W200375-80
Pista australis Hutchings & Glasby	u/f	3,5,7	W200635-7
Pista violacea Hartmann-Schröder	o/f	3	W200906
Reteterebella aloba Hutchings & Glasby	u/f	2,3	W200398
Streblosoma acymatum Hutchings & Rainer	o/f	9	W201377
Terebella pappus Hutchings & Murray	u/a	2,5,7	200404-10
Thelepus boja Hutchings & Glasby	o/f	7	W198918
Thelepus brevicauda Hutchings & Glasby	o/f	7	W201376
Thelepus extensus Hutchings & Glasby	u/a	2,3,5,7	W198916-7
ORDER: SABELLIDA			
FAMILY: SABELLIDAE			
Amphiglena mediterranea (Leydig)	u/f	2,7	W199827-30
Branchiomma nigromaculata (Baird)	r/n	2,3,7	W199831-70

Appendix cont'd.

Megalomma sp.	r/a	2,7	W199812-26
Sabellastarte indica (Savigny)	u/f	2,3,7	W199765-72
FAMILY: SERPULIDAE			
Galeolaria caespitosa Savigny	r/n	2,3,5,6,7	W201358
Hydroides cf. *brachyacantha*	r/a	2,7	W201357
Neovermilia globula Dew	o/f	2,7	W201355
Pomatoceros sp.1	r/a	2,7	W201356
Pomatoceros sp.2	r/n	2,3,7	W201360
Protula sp.1	o/f	7	W201354
Serpula jukesii Baird	u/f	2,3	W201359
Serpula rubens Straughan	u/a	2,3,7	W201352
Serpula sp.1	u/f	2,7	W201353
Spirobranchus tetraceros (Schmarda)	o/f	7	W201351
PHYLUM: MOLLUSCA			
CLASS: POLYPLACOPHORA			
ORDER: NEOLORICATA			
FAMILY: LEPIDOPLEURIDAE			
Parachiton sp.	o/f	7	C148803-4
FAMILY: ISCHNOCHITONIDAE			
Callistochiton antiquus (Reeve)	o/f	7	C150544
Ischnochiton australis Sowerby	r/n	2,3,7	C148821-3
Ischnochiton cariosus (Dall)	r/n	2,3,7	C148813
Ischnochiton elongatus crispus Reeve	r/n	2,3,7	C148824-5
Ischnochiton lentiginosus (Sowerby)	u/f	2	C148820
Ischnochiton smaragdinus (Angas)	u/a	2,3	C148814-6
Ischnochiton versicolor Iredale & Hull	r/a	2,3,7	C148817-9
Ischnochiton sp.1	o/f	2	C148826
Ischnochiton sp.2	o/f	2,7	C148827
FAMILY: MOPALIIDAE			
Plaxiphora albida (Blainville)	r/a	7	C148802
Plaxiphora matthewsi Iredale	u/f	7	C148807-8
FAMILY: SCHIZOCHITONIDAE			
Lorica volvox (Reeve)	o/f	7	C150545
FAMILY: CHITONIDAE			
Chiton jugosus Gould	r/f	2	C148797
Chiton pelliserpentis maugeanus (Iredale & May)	r/n	2,5,6,7	C148798-800
FAMILY: ACANTHOCHITONIDAE			
Acanthochitona pilsbryi (Sykes)	r/n	2,7	C148809-10
Acanthochitona retrojecta (Pilsbry)	r/n	2,7	C148811
Acanthochitona sp.1	u/f	2,7	C148812
Notoplax cf. *rubrostrata*	u/f	2,7	C148805-6
CLASS: BIVALVIA			
ORDER: NUCULOIDA			
FAMILY: NUCULANIDAE			
Nuculana spathula (Hedley)	o/f	9	C150568
Scaeoleda hanleyi (Angas)	r/n	9	C150570
ORDER: SOLEMYOIDA			
FAMILY: SOLEMYIDAE			
Solemya australis (Lamarck)	u/a	2,3	C148522
ORDER: ARCOIDA			
FAMILY: ARCIDAE			
Barbatia pistachia (Lamarck)	u/f	2	C148542
Acar botanica (Hedley)	o/f	2	C148541
FAMILY: GLYCYMERIDIDAE			
Glycymeris flammeus (Reeve)	o/a	8,9	C148794-5

Appendix cont'd.

ORDER: MYTILOIDA			
FAMILY: MYTILIDAE			
Mytilus edulis (Linnaeus)	r/n	2,3,5,6,7	C148548-9
Austromytilus rostratus Dunker	o/f	7	C150549
Trichomya hirsuta (Lamarck)	r/n	2,5,7	C148538-40
Musculus nanus (Dunker)	r/n	7	C148533
Musculus sp.(juv.)	u/n	2,7,9	C148534
Trichomusculus barbatus Reeve	r/n	7	C148537
Modiolus areolatus (Gould)	u/f	7	C148532
Xenostrobus securis (Lamarck)	o/f	2	C150577
ORDER: PTERIOIDA			
FAMILY: PTERIIDAE			
Electroma georgiana (Quoy & Gaimard)	o/f	9	C150558
FAMILY: PULVINITIDAE			
Vulsella vulsella (Linnaeus)	o/f	2,7	C148535
FAMILY: PECTINIDAE			
Mimachlamys asperrimus (Lamarck)	u/f	7	C150563
FAMILY: ANOMIIDAE			
Anomia descripta Iredale	o/f	7	C150548
Anomia ione (Gray)	u/f	3,7	C148530
Monia zealandica (Gray)	o/f	2	C150564
FAMILY: LIMIDAE			
Lima nimbifer (Iredale)	o/f	7	C148536
FAMILY: OSTREIDAE			
Ostraea angasi Sowerby	u/f	5,7	C148793
Crassostrea gigas (Thunberg)	o/f	5	C150556
Saccostrea commercialis (Iredale & Roughley)	r/n	2,5,6,7	C148796
ORDER: VENEROIDA			
FAMILY: LUCINIDAE			
Wallucina assimilis (Angas)	u/f	3	C148523
FAMILY: ERYCINIDAE			
Lasaea australis (Lamarck)	r/n	2,5,6,7	C148545-6
FAMILY: GALEOMMATIDAE			
Ambuscintilla praemium Iredale	r/a	5	C150547
FAMILY: CARDITIDAE			
Cardita excavata Deshayes	o/f	7	C150553
FAMILY: CORDIIDAE			
Acrosterigma cygnorum (Deshayes)	o/f	3	C150546
Fulvia tenuicostata (Lamarck)	o/f	3	C148521
FAMILY: MACTRIDAE			
Spisula trigonella (Lamarck)	o/f	4,5,6	C150572
FAMILY: MESODESMATIDAE			
Mesodesma elongata (Reeve)	o/f	6,9	C148516
FAMILY: SOLENIDAE			
Solen vaginoides (Lamarck)	o/f	9	C150571
FAMILY: TELLINIDAE			
Tellina deltoidalis (Lamarck)	r/n	1,3,4,5,6	C148517
Tellina tenuilirata Sowerby	u/f	9	C150573
Tellina sp.	r/a	3,9	C150574-5
FAMILY: DONACIDAE			
Donax sp. (juv.)	o/f	5,6	C150557
FAMILY: PSAMMOBIIDAE			
Gari sp.	o/f	9	C150559
Sanguinolaria donacioides (Reeve)	o/f	1,6	C148543

Appendix cont'd.

FAMILY: VENERIDAE			
?*Notocallista* sp.	o/f	7	C150567
Eumarcia fumigata (Sowerby)	r/a	1,3,4,5,6	C148525
Venerupis crenata (Lamarck)	r/n	2,5,6,7	C148518
Venerupis fabagella (Deshayes)	u/a	2,3,7	C148519-20
Bassina pachyphylla (Jonas)	o/f	9	C150551
Placamen placidum (Philippi)	o/f	9	C150569
Timoclea cardiodes (Lamarck)	o/f	3	C148524
ORDER: MYOIDA			
FAMILY: CORBULIDAE			
Corbula smithiana Brazier	o/f	5,9	C150554-5
FAMILY: TEREDINIDAE			
Teredo sp.	o/f	2	C150576
Bankia sp.	o/f	1	C150550
FAMILY: HIATELLIDAE			
Hiatella australis (Lamarck)	r/n	7,9	C148531
ORDER: PHOLADOMYOIDA			
FAMILY: LATERNULIDAE			
Laternula creccina Reeve	o/f	9	C150560-1
Laternula cf. *creccina*	o/f	1,5	C148544
FAMILY: MYOCHAMIDAE			
Myadora pandoriformis (Stutchbury)	o/f	9	C150565
CLASS: GASTROPODA			
SUBCLASS: PROSOBRANCHIA			
ORDER: ARCHAEOGASTROPODA			
FAMILY: HALIOTIDAE			
Haliotis ruber (Leach)	u/f	2,7	C148851
FAMILY: FISSURELLIDAE			
Amblychilepas javanicensis (Lamarck)	o/f	7	C150578
Diodora lineata (Sowerby)	o/f	2	C150580
Emarginula sp.	o/f	7	C148850
Scutus antipodes Montfort	r/a	2,3,7	C148848
Scutus sp. (juv.)	u/f	2	C148849
FAMILY: PATELLIDAE			
Cellana tramoserica (Holten)	r/n	2,5,6,7	C148828-9
?*Cellana tramoserica*	o/f	2	C150579
Patella chapmani (Tenison-Woods)	u/f	2,7	C148845-7
Patella peroni (Blainville)	r/a	2,7	C148842-3
FAMILY: ACMAEIDAE			
Notoacmea flammea (Quoy & Gaimard)	u/f	2,7	C148844 C150584
Notoacmea petterdi (Tenison-Woods)	r/n	2,7	C148841
Patelloida alticostata (Angas)	r/n	2,7	C148830-1
Patelloida latistrigata (Angas)	r/a	2,7	C148832-4
Patelloida mimula (Iredale)	r/n	5,6	C148835-7
Patelloida mufria (Hedley)	r/n	2,3,7	C148838-40
FAMILY: TROCHIDAE			
Austrocochlea concamerata (Wood)	r/n	2,7	C148493
Austrocochlea constricta (Lamarck)	r/n	2,5,6,7	C148496-7
Austrocochlea sp. (juv.)	o/f	2,7	C148498
Bankivia fasciata (Menke)	u/n	9	C148390
Cantharidella picturata (A. Adams & Angas)	u/a	2,7	C148374-5
Euriclanculus floridus (Philippi)	r/f	2,7	C148372-3
Eurytrochus strangei (A. Adams)	r/n	2,3,7	C150581
Gena impertusa (Burrow)	r/a	2,3,7	C148369
Granata imbricata (Lamarck)	r/f	2	C148370-1
Herpetopoma aspersa (Philippi)	r/n	2,7	C148367-8

Appendix cont'd.

Kerguelenella stoweai (Verco)	o/f	2	C150582
Leiopyrga lineolaris (Gould)	u/n	9	C148389
Mesoclanculus plebejus (Philippi)	u/a	2	C150583
Montfortula rugosa (Quoy & Gaimard)	r/n	2,7	C148852
Phasianotrochus eximus (Perry)	o/f	2	C148350
Phasianotrochus sp.	u/a	2,3	C150585
Thaliota sp.	u/f	2,7	C148357
Tugali sp.	u/f	2,7	C148861
FAMILY: TURBINIDAE			
Astraea tenforiformis sirius (Gould)	r/a	2,7	C148499
Astralium sp.	o/f	2	C148500
Turbo torquatus (Gmelin)	o/f	2,7	C148502
Turbo undulatus (Solander)	r/a	2,7	C148364-5
FAMILY: NERITIDAE			
Nerita atramentosa (Reeve)	r/n	2,5,7	C148494
ORDER: MESOGASTROPODA			
FAMILY: LITTORINIDAE			
Bembicium auratum (Quoy & Gaimard)	r/n	2,5,6	C148510-1
Bembicium nanum (Lamarck)	r/n	5,7	C148508-9
Nodilittorina pyramidalis (Quoy & Gaimard)	u/a	2,5,7	C148346
Nodilittorina unifasciata (Gray)	r/n	2,5,7	C148345
FAMILY: ASSIMINEIDAE			
Assiminea tasmanica Tenison-Woods	o/f	1	C150586
FAMILY: ARCHITECTONICIDAE			
Philippia lutea (Lamarck;	o/f	7	C148366
FAMILY: VERMETIDAE			
Serpulorbis sipho (Lamarck)	o/f	7	C148507
FAMILY: PLANAXIDAE			
Hinea braziliana Lamarck	o/a	2,7	C15088-9
FAMILY: POTAMIDIDAE			
Pyrazus ebeninus (Bruguiere)	r/f	5,6	C150590
Velacumantus australis (Quoy & Gaimard)	r/n	5,6	C148391-2
FAMILY: CERITHIIDAE			
Bittium sp.	r/n	2,3,7	C148405-7
FAMILY: CREPIDULIDAE			
Crepidula aculeata Gmelin	o/f	2	C150587
FAMILY: NATICIDAE			
Polinices melastomum (Swainson)	o/f	5	C148354
FAMILY: RANELLIDAE			
Cabestana spengleri (Perry)	o/f	8	C148503
Charonia lampax rubicunda (Perry)	o/f	8	C148506
Ranella australasia (Perry)	u/f	2,7	C148504-5
Septa parthenopea (von Salis)	o/f	7	C150591
ORDER: NEOGASTROPODA			
FAMILY: MURICIDAE			
Agnewia tritoniformis (Blainville)	r/a	2,7	C148358
Bedeva hanleyi (Angas)	r/a	2,3,5,6	C1548361
Bedeva sp. (juv.)	o/f	3	C148362
Chicoreus denudatus (Perry)	o/f	7	C148359
Haustrum vinosum (Quoy & Gaimard)	r/a	2	C148355
'Lepsiella' reticulata (Blainville)	u/f	2	C148356
Mesoginella cf. *translucida*	o/f	7	C148387
Mesoginella turbinata (Sowerby)	u/a	9	C148388
Morula marginalba (Blainville)	r/n	2,7	C148495
Thais orbita (Gmelin)	r/n	2,7	C148501

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FAMILY: COLUMBELLIDAE			
Mitrella leucostoma (Gaskoin)	o/f	3	C148377-8
Mitrella lincolnensis (Reeve)	o/f	2,3	C148379-80
Mitrella pulla (Gaskoin)	u/f	2,7	C148381-3
Mitrella sp.	u/f	2,7	C148384-6
FAMILY: BUCCINIDAE			
Cominella lineolata (Lamarck)	r/a	2	C148352-3
FAMILY: NASSARIIDAE			
Nassarius burchardi (Dunker)	r/a	3,4,5,6	C148402
Nassarius cf. *burchardi*	o/f	3	C148401
Nassarius glans particeps (Hedley)	o/f	2,7	C148403
Nassarius pauperatus (Lamarck)	r/n	2,3,7	C148400
Nassarius pauperus (Gould)	o/f	7	C148404
Nassarius sp. (juv.)	u/a	2,3,9	C148399
FAMILY: OLIVIDAE			
Olivella leucozona Adams & Angas	o/f	9	C148376
FAMILY: TURRIDAE			
Guraleus pictus (Adams & Angas)	u/f	3,7	C148363
FAMILY: CONIDAE			
Conus anemone Lamarck	o/f	2	C148351
SUBCLASS: OPISTHOBRANCHIA			
ORDER: BULLOMORPHA			
FAMILY: BULLIDAE			
Bulla quoyii (Gray)	o/f	3	C148360
FAMILY: PHILINIDAE			
Philine cf. *angasi*	o/f	3	C148866
ORDER: ANASPIDEA			
FAMILY: APLYSIDAE			
Aplysia sydneyensis Sowerby	o/f	1	C148512
ORDER: NOTOSPIDEA			
FAMILY: PLEUROBRANCHIDAE			
Pleurobranch sp. 1	o/f	2	C148865
ORDER: NUDIBRANCHIA			
SUBORDER: DORIDACEA			
FAMILY: DORIDIDAE			
Aphelodoris varia (Abraham)	o/f	7	C150593
Dorid Nudibranch sp. 1	o/f	7	C148862
Dorid Nudibranch sp. 2	o/f	7	C148863
FAMILY: CHROMODORIDIDAE			
Ceratosoma amoena (Cheeseman)	o/f	7	C150596
FAMILY: POLYCERIDAE			
Polycera capensis (Quoy & Gaimard)	o/f	7	C150597
SUBORDER: AEOLIDACEA			
FAMILY: GLAUCIDAE			
Austraeolis cacaotica (Stimpson)	o/f	7	C150594
Pteraeolidia ianthina (Angas)	o/f	7	C150598
SUBORDER: ARMINACEA			
FAMILY: JANOLIDAE			
Caldukia affinis (Burn)	o/f	3	C150595
SUBCLASS: PULMONATA			
ORDER: SYSTELLOMMATOPHORA			
FAMILY: ELLOBIIDAE			
Ophicardelus ornatus (Ferussac)	r/n	6	C148393-4
Ophicardelus quoyi (H. & A. Adams)	r/a	6	C148396-7

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Ophicardelus cf. *quoyi*	o/f	6	C148395
Ophicardelus sulcatus (H. & A. Adams)	u/f	6	C148398
FAMILY: ONCHIDIIDAE			
Onchidella patelloides (Quoy & Gaimard)	r/a	2,5,6	C148859-60
Onchidina australis (Semper)	r/f	6	C148864
ORDER: BASOMMATOPHORA			
FAMILY: SIPHONARIIDAE			
Salinator fragilis (Lamarck)	r/n	1,4,5,6	C148347-8
Salinator solida (von Martens)	r/n	1,6	C148349
Siphonaria denticulata Quoy & Gaimard	r/a	2,7	C148853
Siphonaria diemenensis Quoy & Gaimard	r/n	2,5,7	C148854-5
Siphonaria funiculata Reeve	r/a	2,7	C148856
Siphonaria sp. (juv.)	o/f	7	C148857-8
ORDER: SIGMURETHRA			
Theba pisana (Muller)	o/f	1	C150600
CLASS: SCAPHOPODA			
ORDER: GADILIDA			
FAMILY: SIPHONODENTALIIDAE			
Cadulus acuminatus Tate	u/n	9	C150969
PHYLUM: ARTHROPODA			
CLASS CRUSTACEA			
SUBCLASS: OSTRACODA			
ORDER: MYODOCOPA			
Myodocopa spp.	r/n	2,3,7,9	P36562-83
SUBCLASS: CIRRIPEDIA			
ORDER: THORACICA			
Austrobalanus imperator (Darwin)	f	7	P36114
Austromegabalanus nigrescens (Lamarck)	a	7	P36119
Balanus trigonus Darwin	n	2,7	P36112
Balanus variegatus Darwin	f	6	P36614
Catomerus polymerus (Darwin)	a	2,7	P36122
Chamaesipho columna (Spengler)	n	2,7	P36120
Chthamalus antennatus Darwin	n	2,7	P36124
Elminius covertus Foster	n	2,5,6	P36125
Ibla quadrivalvis Cuvier	f	2,7	P36113
Notomegabalanus algicola (Pilsbry)	n	2,7	P36116-8
Tesseropora rosea Krauss	a	2,7	P36121
Tetraclitella purpurascens (Wood)	n	2,7	P36123
SUBCLASS: MALACOSTRACA			
ORDER: LEPTOSTRACA			
Neballiacean sp.	o/f	9	P36584-7
SUPERORDER: PERACARIDA			
ORDER: MYSIDACEA			
Heteromysis sp.	u/f	2,7	P36617-9
Siriella australis W. M. Tattersall	o/f	7	P36615-6
ORDER: CUMACEA			
Cumacean spp.	r/n	1,3,5,7,9	P36594-613
ORDER: TANAIDACEA			
Tanaidacean spp.	r/n	2,3,7,9	P36525-48
ORDER: ISOPODA			
SUBORDER: GNATHIIDEA			
Gnathia ferox (Haswell)	u/f	3,7	P36588-91
SUBORDER: ANTHURIDEA			
Apanthura drosera Poore & Lew Ton	o/f	9	P36050

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Apanthura isotoma Poore & Lew Ton	u/f	9	P36046-8
Apanthura xanthorrhoea Poore & Lew Ton	r/a	2,3,7	P35640-2
			P36154-6
Apanthuretta olearia Poore & Lew Ton	o/f	9	P36049
			P36059
Bullowanthura pambula Poore	o/f	9	P36052
Cyathura hakea Poore & Lew Ton	o/f	4	P36593
Haliophasma canale Poore	o/f	9	P36058
Haliophasma sp. 1	o/f	2,7	P36061-2
			P36592
Haliophasma sp. 2	o/f	9	P36056-7
			P36133-5
Leptanthura diemenensis (Haswell)	r/a	2,3,9	P35648-9
			P36053-5
			P36170-2
Mesanthura dianella Poore & Lew Ton	u/f	2,3,7	P35643-5
			P36149
Paranthura acacia Poore	o/f	9	P36060
Paranthura senecio Poore	r/f	2,7	P35646-7
			P36167-9
Ulakanthura marlee Poore	o/f	9	P36051
SUBORDER: FLABELLIFERA			
Amphoroidea angustata Baker	o/f	2	P35957
Cerceis ?obtusa	o/f	2	P36625
Cirolana australiense Hale	r/n	2,3,7,9	P35961
			P36146-8
Cirolana victoriae Bruce	o/f	9	P35972
Cilicaea tenuicauda Haswell	o/f	2	P36626
Cilicaeopsis cf. *whiteleggei*	o/f	2	P36627
Cilicaeopsis sp.	o/f	9	P35970
Cymodoce cf. *bidentata*	o/f	9	P35969
			P36178
Cymodoce haswelli Harrison & Holdich	u/f	2,7	P36628
Cymodoce spp. (females)	r/n	2,3,7	P35948-9
			P35954
			P35960
			P36145
			P36173-4
			P36623-4
?Cymodopsis sp.	o/f	2	P35955
Cymothoid sp.	o/f	3	P36631
Eurydice ?binda	o/f	7	P36629
Eurydice sp.	o/f	9	P35971
Eurylana arcuata (Hale)	r/f	2,7,9	P35958
			P36175-7
Exosphaeroma sp.	o/a	2,7	P35959
Haswellia carnea (Haswell)	o/f	2,7	P35950
			P36144
Haswellia cf. *juxtacarnea*	o/f	2,7	P35951
			P36159-60
Ischromene ?polytyla	r/n	7	P35953
			P36165-6
Limnoria sp.	r/a	2,7	P35952
			P36157-8
?Paracilicaea sp.	u/f	2,7	P36622
Paracassidina pectinata Baker	o/f	9	P35963
			P36179
Pseudolana towrae Bruce	o/f	5,9	P35966-7
Serolis minuta Beddard	o/f	9	P35964-5
Sphaeromatid sp. 1	o/f	2	P35956

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Sphaeromatid sp. 2	o/f	9	P35962
Sphaeromatid sp. 3	u/f	2,7	P36620
Sphaeromatid sp. 4	o/f	2	P36621
Sphaeromatid sp. 5	o/f	7	P36630
Syncassidina aesturia Baker	u/f	3,4,5	P35968
			P36143
SUBORDER: ONISCOIDEA			
Oniscoidean sp. 1	o/f	4,5	P36633-6
Oniscoidean sp. 2	o/f	6	P36632
SUBORDER: VALVIFERA			
Euidotea cf. *peronii*	o/f	9	P36068
Microarcturus sp.	o/f	9	P36071
Neoarcturus sp.	o/f	9	P36070
Pseudarcturella sp.	o/f	9	P36072
Synidotea sp.	o/f	9	P36069
SUBORDER: ASELLOTA			
Ianiropsis sp.	r/n	2,7	P35658-9
			P36152-3
Iathrippa sp.	r/n	2,7	P35653-5
			P36150-1
Jaeropsis sp. 1	r/n	2,7	P35660-2
			P36163-4
Jaeropsis sp. 2	o/f	2	P36064-5
Janirid sp. 1	o/f	7	P36066
Janirid sp. 2	o/f	7	P36067
Stenetrium armatum Haswell	u/n	7	P35650-2
			P36161-2
Stenetrium cf. *armatum*	o/f	2	P36063
ORDER: AMPHIPODA			
SUBORDER: GAMMARIDEA			
FAMILY: AMPELISCIDAE			
Ampelisca dimboola Lowry & Poore	o/f	9	P36660
Ampelisca euroa Lowry & Poore	r/f	2,3,7	P36638
Byblis bega Lowry & Poore	o/f	9	P36659
FAMILY: AMPHILOCHIDAE			
Cyproidea ornata Haswell	r/n	2,3	P36709
Narapheonoides mullaya J. L.Barnard	o/f	3	P36708
FAMILY: AMPITHOIDAE			
Ampithoe sp. 1	o/a	2	P36005
Ampithoe sp. 2	u/f	2,3,7	P36712
Ampithoe sp. 3	u/f	7	P36706
Ampithoe sp. 4	o/f	2	P36713
Ampithoe sp. 5	o/f	7	P36707
Cymadusa sp. 1	u/f	7	P35993
Cymadusa sp. 2	o/f	3	P36710
?Pseudopleonexes sp.	o/f	7	P36705
FAMILY: ANAMIXIDAE			
Anamixis sp.	o/f	2	P36651
			P36714
FAMILY: AORIDAE			
Aora hebes Myers & Moore	r/n	7	P35992
			P36187-8
Aora maculata (Thomson)	u/n	2,7	P36014-5
Aora mortoni (Haswell)	r/n	2,3,9	P36032
			P36181
Lemboides australis (Haswell)	r/a	2,3,7	P36031
			P36189

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Lembos aequimanus Schellenberg	r/f	2,3	P36033 P36180
Xenocheira fasciata Haswell	o/f	2	P36007
FAMILY: COROPHIIDAE			
Corophium sp.	r/n	2,3,7	P36641
Paracorophium ?excavatum	r/n	4,5,6	P36042
Siphonoecetes spp.	o/f	7,9	P36295-306
FAMILY DEXAMINIDAE			
Atylus homochir Haswell	r/a	2,3	P36029
Haustoriopsis sp. 1	r/a	3	P36028
Haustoriopsis sp. 2	o/f	3	P36027
Paradexamine churinga J. L. Barnard	o/f	2	P36005
Paradexamine dandaloo J. L. Barnard	o/f	9	P36043
Paradexamine frinsdorfi Sheard	u/f	7	P35991
Paradexamine lanacoura J. L. Barnard	r/a	2,3	P36026
Paradexamine ?quarallia	o/f	3	P36711
Paradexamine ?thadalee	r/n	2,3,7	P36025 P36203
Polycheira tenuipes Haswell	o/f	7	P36703
Syndexamine cf. *runde*	o/f	2	P36009
Syndexamine sp. 1	u/f	3	P36024
FAMILY: EUSIRIDAE			
Gondogeneia microdeuteropa (Haswell)	r/a	2,7	P35973
Meteusiroides sp.	r/a	2,7	P36004
?Paramoera sp.	o/f	2,7	P36012
Tethygeneia nalgo J. L. Barnard	r/n	2,3,7	P36010
Tethygeneia waminda J. L. Barnard	o/n	7,9	P36040
FAMILY: EXOEDICEROTIDAE			
Exoediceroides maculosus (Sheard)	o/f	4	P35639
FAMILY: HYALIDAE			
Hyale crassicornis (Haswell)	r/f	2,7	P35977 P36185-6
Hyale cf. *loorea*	u/a	7	P36645
Hyale maroubrae Stebbing	u/f	2,7	P36013 P36184
Hyale rubra (Thomson)	u/f	2,7	P36182-3 P35976
Hyale sp.	r/f	2,7	P36646
FAMILY: ISAEIDAE			
Ampelisciphotis sp.	r/n	2,3,7,9	P36030
Cheiriphotis sp.	o/f	2,7,9	P35994-5
Gammaropsis sp.	r/a	2,3,7	P36003
?Gammaropsis sp. 1	r/n	2,7	P35985
?Gammaropsis sp. 2	u/f	2,7	P36002
?Gammaropsis sp. 3	r/a	2,7	P35984
Photis sp. 1	r/n	2,3,7,9	P36034-5 P36190-1
Photis sp. 2	o/f	9	P36018 P36102-4
FAMILY: ISCHYROCERIIDAE			
Cerapus sp.	o/f	3,9	P36195-202 P36006
Ericthonius sp.	r/n	2,3,7	P36023
Parajassa sp.	u/n	3,7	P36704
FAMILY: LEUCOTHOIDAE			
Leucothoe assimilis J. L. Barnard	o/f	7	P36642

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Leucothoe boolpooli J. L. Barnard	r/n	2,3,7	P35990 P36213
Leucothoe commensalis Haswell	r/a	2,3,7	P35983 P36214
Paraleucothoe novaehollandiae (Haswell)	r/a	2,7	P35989 P36215
FAMILY: LILJEBORGIIDAE			
Liljeborgia aequabilis Stebbing	r/a	2,3,7	P36001 P36216
Liljeborgia sp. 1	o/f	3	P36022
Liljeborgia sp. 2	o/f	9	P36038
FAMILY: LYSIANASSIDAE			
Amaryllis sp. 1	o/f	2,7	P36700
Amaryllis sp. 2	o/f	2,3,9	P36701
Amaryllis sp. 3	r/a	2,7	P35982 P36702
Lysianassid sp. 1	u/f	7	P35981 P36212
Parawaldeckia dilkera J. L. Barnard	r/f	2,3,7	P36021 P36211
Parawaldeckia sp.	r/f	9	P36207-9 P36044-5
Tryphosella camelus (Stebbing)	u/f	2,3,9	P36016-7 P36210
Uristidid sp. 1	o/f	9	P36204-6 P36036
Waldeckia sp.	r/n	7	P35988
FAMILY: MELITIDAE			
Ceradocus ramsayi (Haswell)	r/n	2,7	P35987 P36229
Ceradocus rubromaculatus (Stimpson)	r/f	2,3,7	P36637
Ceradocus serratus (Bate)	u/f	2,3	P36000 P36218-9
Ceradocus sp.	o/f	2	P36650
?Ceradocus sp.	r/f	2,3,7	P36644
Dulichiella australis (Haswell)	r/n	2,7	P35980 P36221
Elasmopus bollonsi Chilton	u/n	7	P35979 P36230
Elasmopus ?yunde	o/f	7	P36644
Gammarella berringar (J. L. Barnard)	o/f	2	P35999
Gammarella mokari (J. L. Barnard)	u/f	2	P35998 P36224-6
Maera viridis Haswell	r/n	2,7	P35978 P36222-3
Maera sp.	o/f	2	P36649
?Maera sp.	r/n	2,7	P36643
Mallacoota subcarinata Haswell	o/f	7	P35988
Melita matilda J. L. Barnard	r/a	1,4,6	P36041 P36227-8
Melita sp.	u/f	2,7	P36647-8
Victoriopisa australiensis (Chilton)	r/a	4,5,6	P36699
FAMILY: PARACALLIOPIIDAE			
Paracalliope sp.	r/n	1,4,6	P35637-8
FAMILY: PHLIANTIDAE			
Gabophlias olono J. L. Barnard	u/f	2	P36011 P36220
Iphiplateia whiteleggei Stebbing	o/f	3	P36020

Appendix cont'd.

FAMILY: PHOXOCEPHALIDAE			
Birubius mayamayi Barnard & Drummond	o/f	2	P36691
Birubius muldarpus Barnard & Drummond	o/f	7	P36698
Birubius cf. *nammuldus*	o/f	2	P36690
Birubius quearus Barnard & Drummond	r/f	2,3	P36694-5
?Birubius sp.	o/f	9	P36697
Brolgus tattersalli (J. L. Barnard)	o/f	2	P36692
Tipimegus dinjerrus Barnard & Drummond	o/f	9	P36696
Wildus sp.	r/a	3	P36693
FAMILY: PODOCERIDAE			
Podocerus sp. 1	o/a	2	P35997
Podocerus sp. 2	r/n	2,3,7	P35996 P36232-3
Podocerus sp. 3	r/a	2,3,7	P36019 P36231
FAMILY: SYNOPIIDAE			
Tiron sp.	o/f	9	P36039
FAMILY: TALITRIDAE			
Orchestia ?australis	r/f	1,6	P36037 P36217
Orchestia sp.	u/f	2,7	P35974 P35975
FAMILY: UROHAUSTORIIDAE			
Gheegerus cf. *garbaius*	o/f	9	P36661
Tottungus ?tungus	o/f	5	P36652
Urohaustorius gunni Barnard & Drummond	o/f	9	P36658
Urohaustorius merkanius Barnard & Drummond	o/f	9	P36656
Urohaustorius metungi Fearn-Wannan	u/f	5	P36653-4
Urohaustorius parnggius Barnard & Drummond	o/f	9	P36657
Urohaustorius ?urungari	o/f	9	P36655
SUBORDER: CAPRELLIDEA			
Caprella danilevskii Czerniavski	o/f	2	P36684-5
Caprella equilibra Say	o/f	7	P36688-9
Caprella scaura Templeton			P36676-7
?Hircella cornigera	o/f	7	P36687
Orthoprotella cf. *mayeri*	u/f	2,3	P36681-3
Paraproto spinosa (Haswell)	o/a	2	P36686
?Paraproto sp.	u/f	3	P36678-90
SUPERORDER: EUCARIDA			
ORDER: DECAPODA			
SUBORDER: NATANTIA			
SECTION: PENAEIDEA			
Penaeus plebejus Hess	u/f	1,3,4,5,6	P36102-3 P36668
?Penaeus sp. (juv.)	o/f	3	P36106
SECTION: CARIDEA			
Alpheus euphrosyne richardsoni Yaldwyn	u/f	1,2,5	P36100 P36666
Alpheus socialis Heller	u/f	7	P36115
Alpheus sp.	u/f	3,7	P36664-5
Alope ?orientalis	*o/f*	*7*	*P36663*
Hippolyte caradina Holthius	u/a	3	P36108
Hippolyte ventricosa Milne-Edwards	o/f	7	P36110
Palaemon affinis Milne-Edwards	r/a	1,3,4,5,6	P36101
Palaemon serenus Heller	o/f	2	P36667
Rhynchocinetes ?rugulosus	o/a	7	P36662
Synalpheus tumidomanus (Paulson)	u/f	2,7	P36105

Appendix cont'd.

SUBORDER: REPTANTIA			
SECTION: MACRURA			
SUPERFAMILY: THALASSINIDEA			
Axiopsis australiensis De Man	o/f	2	P36104
Callianassa arenosa Poore	u/f	5	P36099
SECTION: ANOMURA			
Diogenes custos affinis Henderson	o/f	9	P36111
Diogenes senex Heller	o/f	3,5	P36098
Paguristes squamosus McCulloch	o/f	3,7	P36107
Pagurus ?lacertosus nana	o/f	7	P36109
Pagurus sinuatus (Stimpson)	o/f	7	P36669
Pagurus sp.	o/f	7	P36670
SECTION: BRACHYURA			
Actaea peronii (Milne-Edwards)	o/f	7	P36083
Amarinus paralacustris (Lucas)	u/f	1	P36090
Carcinus maenas (Linnaeus)	r/a	1,2,6	P36248-9
			P36089
Cyclograpsus audouinii Milne-Edwards	r/n	2,6,7	P36076
			P36239
Cyclograpsus cf. *audouinii*	o/f	7	P36080
Halicarcinus ovatus Stimpson	r/n	2,3,7,9	P36095
			P36234-6
Heloecius cordiformis Milne-Edwards	o/f	5	P36086
			P36247
Helograpsus haswellianus (Whitelegge)	r/n	1,6	P36091
			P36242-3
Hymenosoma hodgkini Lucas	o/f	5	P36087
Leptograpsus variegatus (Fabricius)	r/a	2,7	P36079
Macrophthalmus latifrons Haswell	u/a	5	P36085
			P36245-6
Mictyris longicarpus Latreille	r/n	5,6	P36084
Naxia deflexifrons Haswell	o/f	7	P36673
Notomithrax minor (Filhol)	u/a	3,7	P36094
Notomithrax ursus (Herbst)	o/f	3,7	P36675
Ovalipes australiensis Stephenson & Rees	o/f	1,6	P36088
			P36126
Ovalipes sp. (juv.)	o/f	9	P36097
Ozius truncatus (Milne-Edwards)	r/a	2,7	P36081
			P36238
Pachygrapsus laevimanus Stimpson	u/a	2,7	P36075
Paragrapsus laevis (Dana)	r/n	1,6	P36092
			P36240-1
Petalomera lateralis (Gray)	o/f	2	P36073
Pilumnus rufopunctatus Stimpson	r/a	2,7	P36082
			P36237
Pilumnus serratifrons (Kinahan)	r/f	1,2,5,6	P36077
Pilumnus sp.	o/f	7	P36671
Pinnotheres hickmani (Guiler)	o/f	7	P36672
Plagusia chabrus (Linnaeus)	r/f	2,7	P36074
Plagusia glabra Dana	u/f	7	P36078
Portunus pelagicus (Linnaeus)	o/f	3,9	P36096
Sesarma erythrodactyla Hess	r/f	2,5,6	P36244
Xanthias elegans (Stimpson)	o/f	2	P36674
?Xanthid (juv.)	o/f	1,6	
Decapod Larvae	o/f	7,9	
CLASS: PYCNOGONIDA			
Pycnogonid spp.	u/f	2,7	P36549-61

Appendix cont'd.

PHYLUM: SIPUNCULIDA			
Sipunculan spp.	r/a	2,3,5,7	W201423
PHYLUM: BRACHIOPODA			
Magellania flavescens (Lamarck)	o/f	2	C150562
PHYLUM: ECHINODERMATA			
CLASS: ASTEROIDEA			
ORDER: VALVATIDA			
FAMILY: ASTERINIDAE			
Patiriella calcar (Lamarck)	u/a	7	J19849-52 J19887
Patiriella exigua (Lamarck)	r/n	2,7	J19865-73 J19875-76 J198788-92
Patiriella gunni (Gray)	u/a	7	J19853-54 J19874
FAMILY: OREASTERIDAE			
Nectria ocellata E. Perrier	o/f	7	J19855
FAMILY: ASTEROPSEIDAE			
Petricia vernicina (Lamarck)	u/a	2,7	J19856-8
ORDER: SPINULOSIDA			
FAMILY: ECHINASTERIDAE			
Plectaster decanus (Müller & Troschel)	o/f	7	J19864
ORDER: FORCIPULATIDA			
FAMILY: ASTERIIDAE			
Coscinasterias calamaria (Gray)	r/n	2,3,7	J19884-5 J19834-48
Uniophora granifera (Lamarck)	o/a	7	J19859-63
CLASS: OPHIUROIDEA			
ORDER: OPHIURIDAE			
FAMILY: OPHIOCOMIDAE			
Clarkcoma pulchra (H. L. Clark)	o/f	2	J19832
FAMILY: OPHIONEREIDAE			
Ophionereis schayeri (Müller & Troschel)	u/n	2,7	J19826-9
FAMILY: OPHIACANTHIDAE			
?*Ophiacantha* sp.	o/f	9	J19895
FAMILY: OPHIACTIDAE			
Ophiactis resiliens Lyman	o/a	7	J19902-5 J10008-9 J20002
FAMILY: AMPHIRORIDAE			
Amphipholis squamata (Delle Chiaje)	of	2,3,9	J20001 J19899-901
Amphiura constricta Lyman	u/f	2,3,7	J19881-3 J19906
Amphiura micra H. L.Clark	o/f	2,3,7,9	J19877-79 J19907
FAMILY: OPHIOTHRICIDAE.			
Ophiothrix (Ophiothrix) caespitosa Lyman	o/f	7	J19893-4
Ophiothrix (Ophiothrix) cilaris (Lamarck)	o/f	7	J19995-7
Ophiothrix (Placophiothrix) spongicola Stimpson	o/f	7	J19831
CLASS: ECHINOIDEA			
ORDER: CIDAROIDA			
FAMILY: CIDARIDAE			
Phyllacanthus parvispinus Tenison-Woods	r/f	7	J19823-5

Appendix cont'd.

ORDER: DIADEMATOIDA			
FAMILY: DIADEMATIDAE			
Centrostephanus rodgersii (A. Agassiz)	r/a	2,7	J19815
ORDER: TEMNOPLEUROIDA			
FAMILY: TEMNOPLEURIDAE			
Holopneustes inflatus A. Agassiz	o/f	2,7,9	J19910
ORDER: ECHINOIDA			
FAMILY: ECHINOMETRIDAE			
Heliocidaris erythrogramma (Valenciennes)	r/a	2,3,7	J19816-21
Heliocidaris tuberculata (Lamarck)		2,7	J19822
CLASS: HOLOTHUROIDEA			
ORDER: DENDROCHIROTIDA			
FAMILY: CUCUMARIIDAE			
Pentacta ignava (Ludwig)	o/f	2,7	J19896-8
Pseudocnus sp.	u/a	2	J19909
ORDER: MOLPAIIDA			
FAMILY: CAUDINIDAE			
Paracaudina chilensis var. *ransonnetti* (von Marenzeller)	o/f	9	J19908
CLASS: CRINOIDEA			
ORDER: COMATULIDA			
FAMILY: COMASTERIDAE			
Cenolia tasmaniae (A. H. Clark)	o/f	7	J19833
PHYLUM: CHORDATA			
SUBPHYLUM: TUNICATA			
CLASS: ASCIDIACEA			
ORDER: PLEUROGONA			
FAMILY: STYELIDAE			
Styela plicata (Lesueur)	o/f	3	Y2060
FAMILY: PYURIDAE			
Herdmania momus (Savigny)	r/n	2,7	Y2061-65
Pyura gibbosa (Heller)	r/n	2,7	Y2057-59
Pyura spinifera (Quoy & Gaimard)	o/f	7	Y2049
Pyura stolonifera (Heller)	r/n	7	Y2050-56
PHYLUM: CHORDATA			
GRADE: PISCES			
ORDER: AMPHIOXIFORMES			
FAMILY: BRANCHIOSTOMATIDAE			
Amphioxus sp.	o/f	9	I26021-002
ORDER: ANGUILLIFORMES			
FAMILY: ANGUILLIDAE			
Anguilla australis Richardson	o/f	4,6	I26017-001 I26018-001
FAMILY: OPHICHTHIDAE			
Muraenichthys sp.	o/f	9	I26019-001
ORDER: SCORPAENIFORMES			
FAMILY: SCORPAENIDAE			
Ruboralga ergastulorum (Richardson)	o/f	3	I26007-001
Scorpaenidae sp.	o/f	4,6	I26015-003
Centropogon australis (White)	o/f	6	I26015-002
ORDER: PERCIFORMES			
FAMILY: CLINIDAE			
Heteroclinus heptaeolus (Ogilby)	o/f	2,7	I26008-001 I26010-001

Appendix cont'd.

FAMILY: GOBIIDAE			
Arenigobius bifrenatus (Kner)	o/f	5	I26020-001
Favonigobius tamarensis (Johnson)	o/f	5	I26014-002
Philypnodon grandiceps (Kreft)	o/f		I26016-001
Pseudogobius olorum (Sauvage)	o/f	1,5,6	I26013-001
			I26014-001
			I26015-001
Pseudogobius sp.	o/f	1	I26011-001
			I26009-001
FAMILY: SERRANIDAE			
Epinephelus sp.	o/f	7	I26012-001